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ECMWF Climatology
Ocean Emissivity Trends
2010-04-23

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ECMWF Climatology

- **I Discussed ECMWF Climatology in May & Sept 2009 AIRS Science Team meetings**
  - **We extract ECMWF forecast at AIRS overpass locations/times**
    - Separate by land/ocean
    - Produce Level-2 simulated files
  - **Process to Level-3 daily and monthly files**
  - **Roll up multiple years to monthly climatology files in AIRS Level-3 format**
  - **Software used in Level-2 retrieval extracts appropriate info given month, latitude, longitude, ascending vs. descending, land fraction**
    - Files and software are available to the science team

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ECMWF Climatology

- **Progress since September 2009:**
  - **ECMWF climatology now replaces the old NCEP/UARS climatology as the default background in the JPL retrieval system**
    - This has limited effect on retrievals because both MW-only and regression completely ignore the background except above 100 hPa
    - When both regression and MW-only retrieval steps are skipped this leaves a better starting point for cloud clearing + physical retrieval
  - **More ECMWF forecast data has been received.**
    - 6+ years with many small gaps and a few large ones.
    - Thanks Scott!
  - **More ECMWF forecast has been processed to L3 for incorporation.**
    - 59 months 2003-2009
  - **New ECMWF Clim with 3-4 years for each month (2005-8)**
    - Soon to be 4-6 with the addition of 2009
    - Standard deviation now more fully reflects interannual variability

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ECMWF Climatology Gotchas: Tropopause

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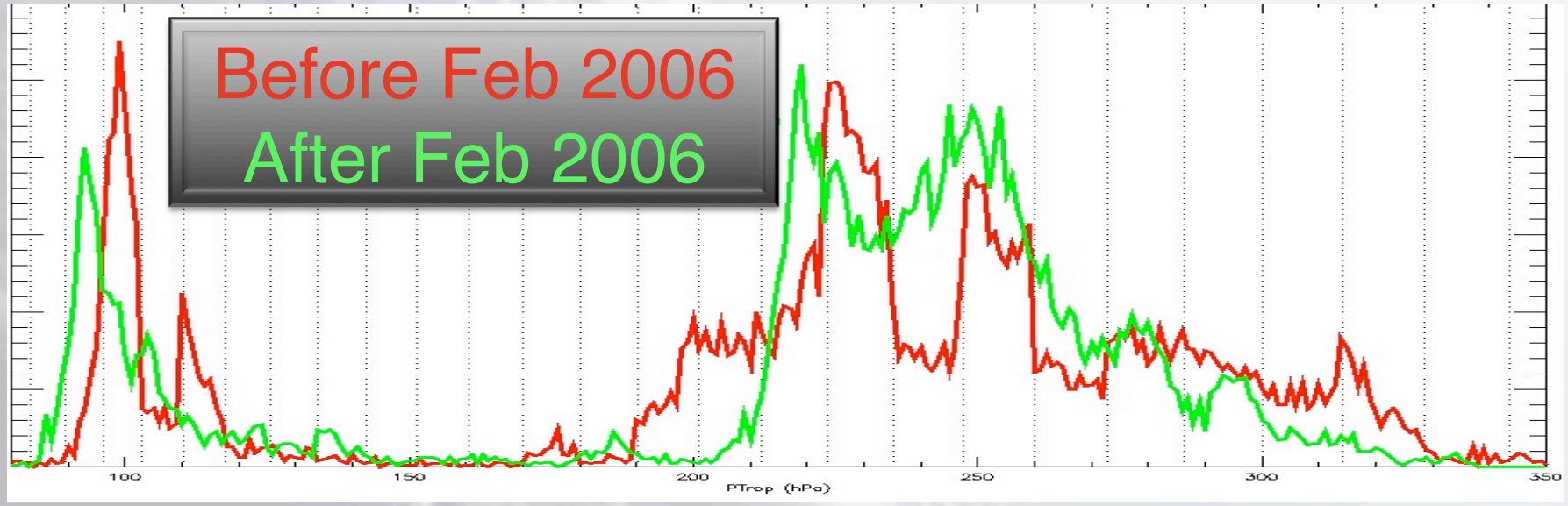

- This is a histogram of the tropopause pressure
- Before Feb 2006 ECMWF had 60 vertical layers
- Since Feb 2006 ECMWF has 91 vertical layers
  - Spatial resolution also increased from ½ to ¼ degree
- Interpolation of temperature profiles gives some layers which cannot have a tropopause or other kink
- This effect can be seen in AIRS v5 retrievals because pre-2006 ECMWF was used to train the regression
  - If we're going to use tropopause-relative trace-gas climatologies then we really need a good tropopause

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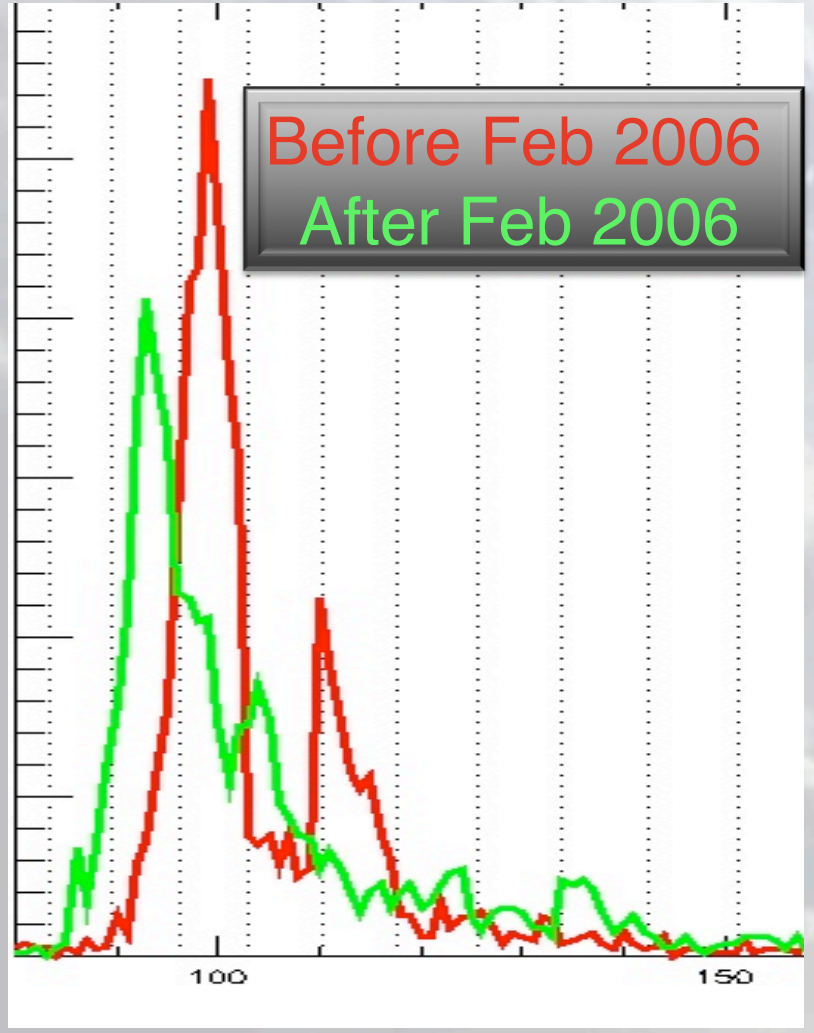
ECMWF Climatology Gotchas: Tropical Tropopause Detail



- **Since February 2006 (91 layers):**
  - **The distribution of tropopauses is relatively continuous.**
  - **The peak of the distribution of tropical tropopauses is ~93 hPa.**
- **Before February 2006 (60 layers):**
  - **The distribution is discontinuous at bin boundaries**
  - **The peak is sharper and is shifted to ~100 hPa**

ECMWF Gotchas: ECMWF changes

- **ECMWF is an operational forecast, not a consistent reanalysis.**
- **They update their model frequently**
  - **http://www.ecmwf.int/products/data/operational_system/evolution/**

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ECMWF Climatology Gotchas: Day/Night Tsurf differences

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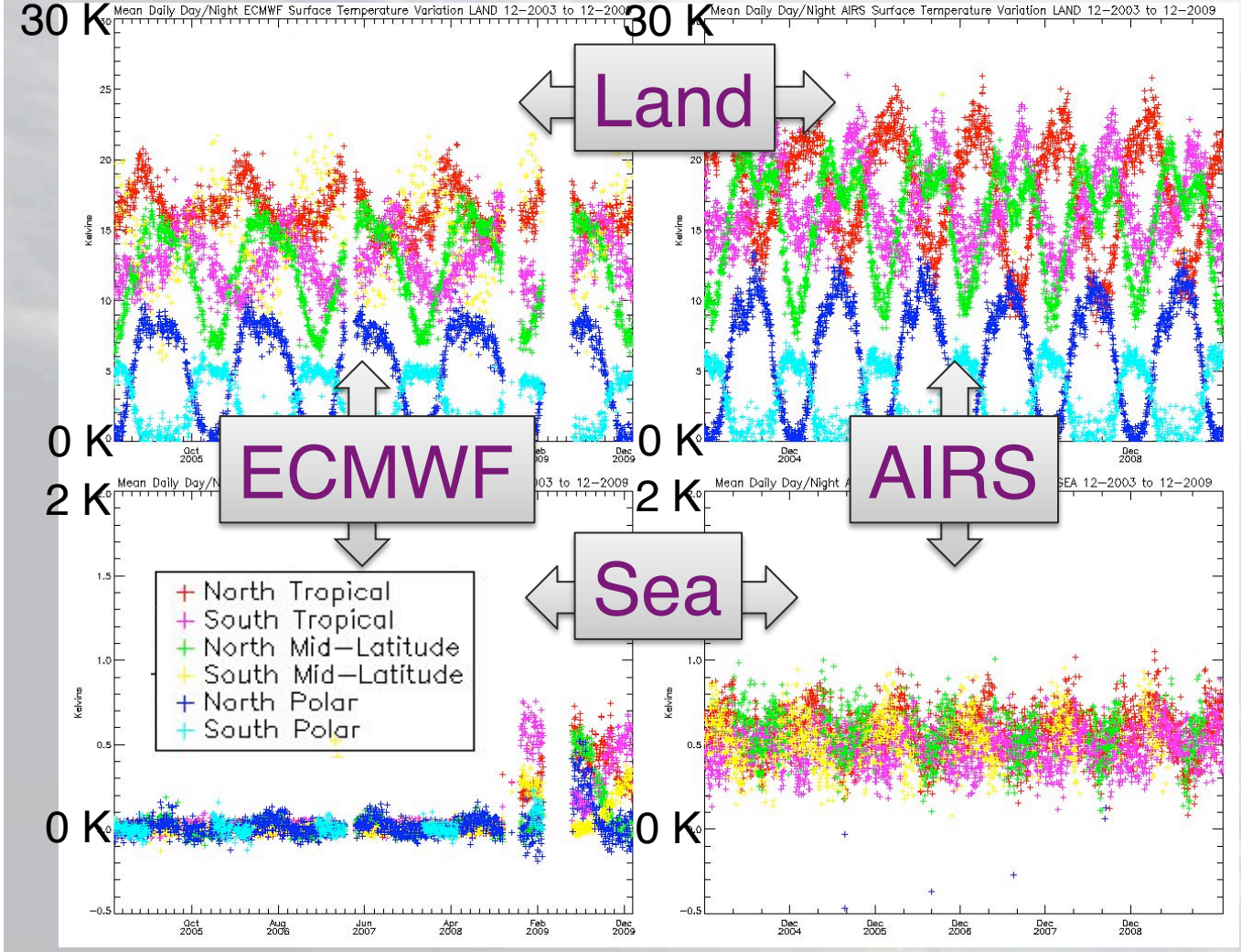

- **Each quadrant shows a time series of day – night surface temperature 2005-2009**
- **For land, AIRS and ECMWF agree well**
- **For ocean, ECMWF showed no day/night differences until Dec 2008**

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ECMWF Climatology Gotchas: Day/Night Tsurf differences

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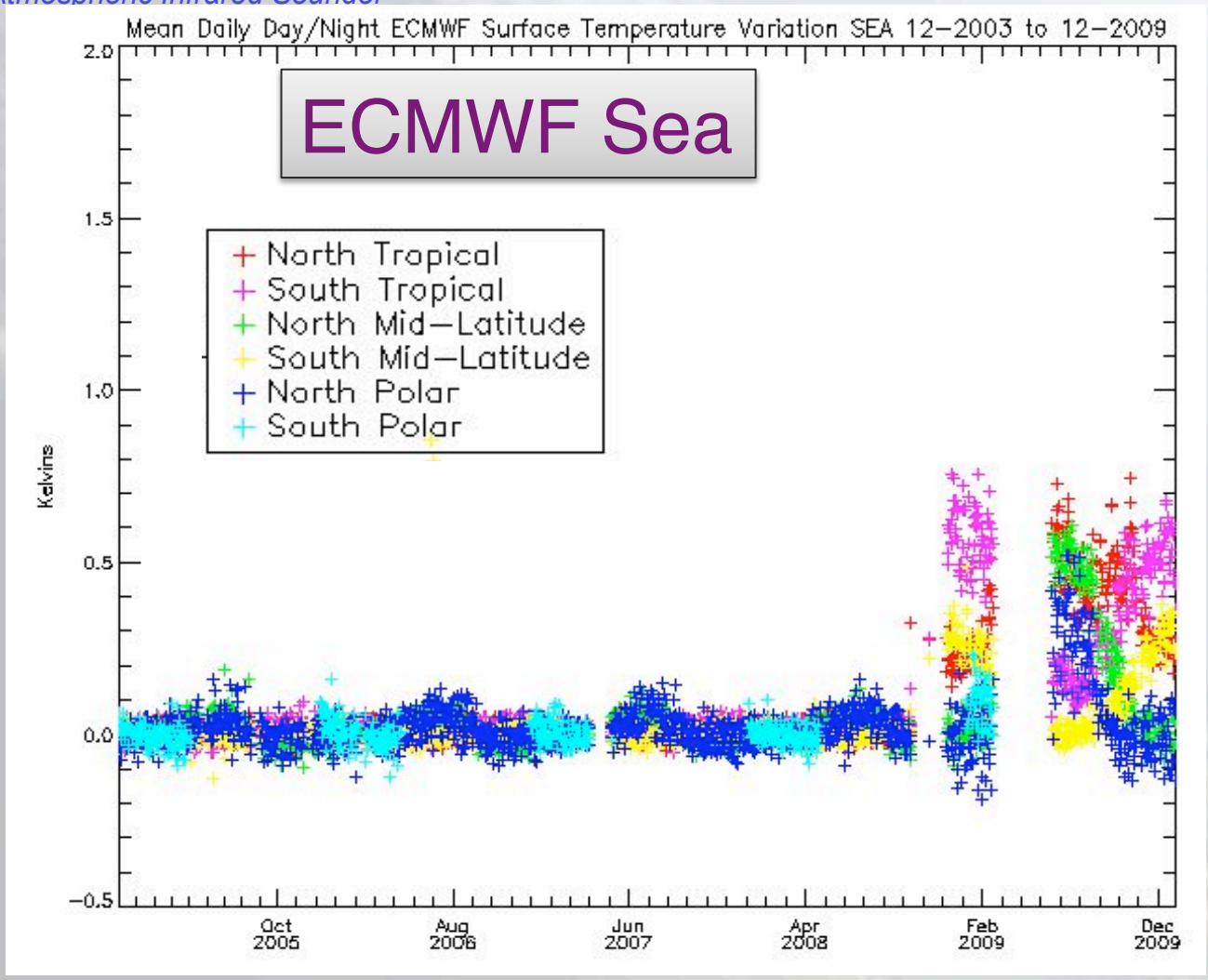

- **ECMWF Ocean showed no day/night differences until Dec 2008**
- **Zonal means now vary seasonally between ~0.0 and ~0.5 K.**
- **Still somewhat smaller than AIRS**

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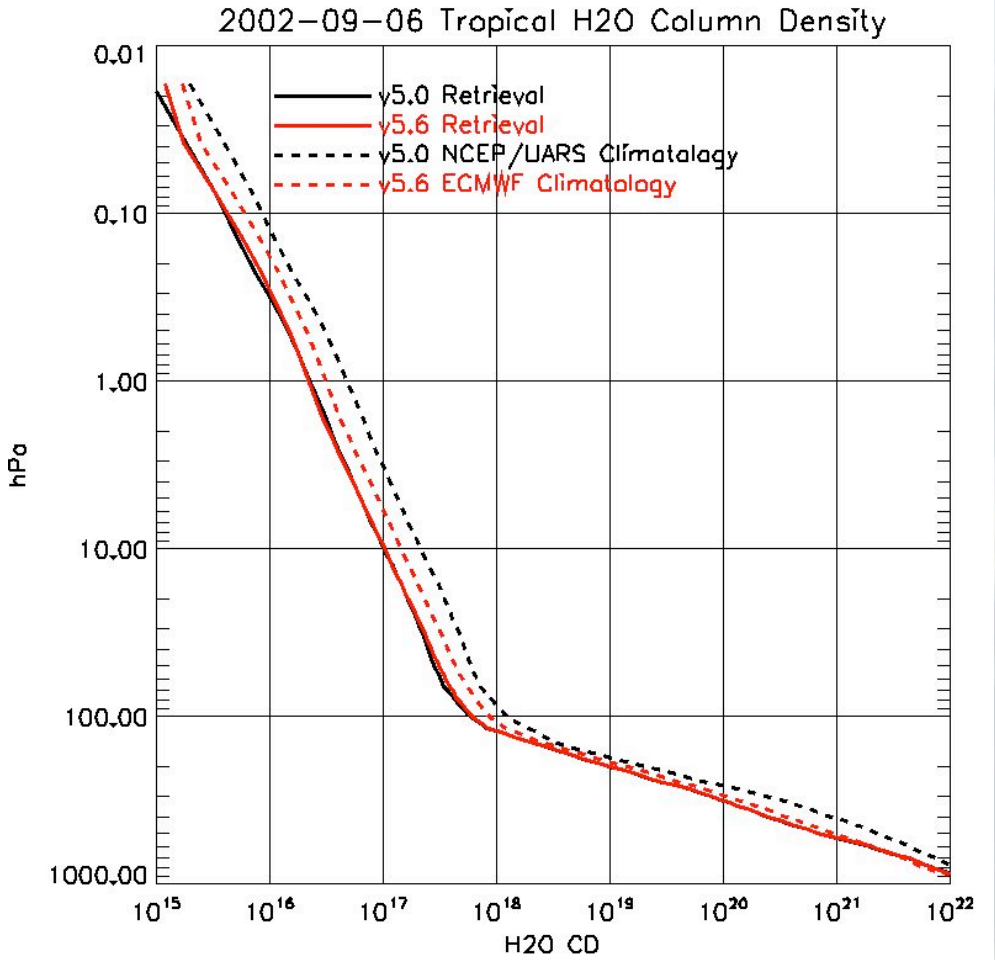
ECMWF Gotchas: Stratospheric H2O



- **The AIRS L2 retrieval largely uses its climatology guess H2O above 100 hPa unchanged**
  - **It is adjusted to match at 100 hPa**
- **For this tropical case:**
  - **The new ECMWF clim is drier than the old NCEP/UARS clim**
  - **But the shape is similar so, after shifting, the retrieved strat H2O is similar**

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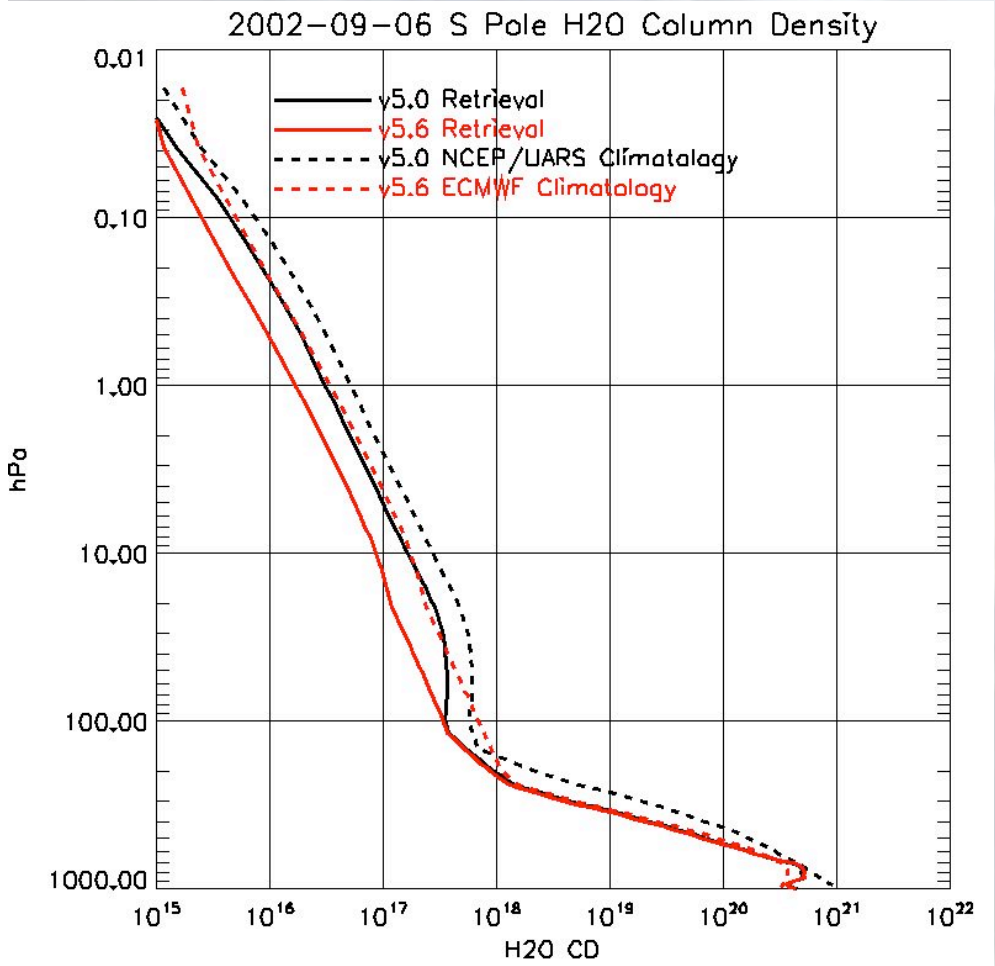
ECMWF Gotchas: Stratospheric H2O



- **For this south polar case:**
  - **The new ECMWF clim is much drier than the old NCEP/ UARS clim**
  - **The shape is very different around 100 hPa.**
  - **The retrieved strat H2O is much drier**

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Climatology Conclusions

Problems arise with a simple collection of ECMWF data for climatology:

- **Bad tropopause structure if we use data before February 2006**
- **Problems with polar stratospheric H2O**
- **Day/Night differences underpredicted if we use data before December 2009**

An excellent AIRS-specific climatology could be built if demand is high enough:

- **Adjust polar 100 hPa structure**
- **Merge different fields from different time ranges**
  - **Standard deviations from the entire mission to get interannual variability**
  - **Fine vertical structure using one data since Feb 2006**
  - **Ocean Tsurf only since Dec 2009**

Bonus Topic:
Ocean Emissivity Trends

V5.0 vs. V5.6

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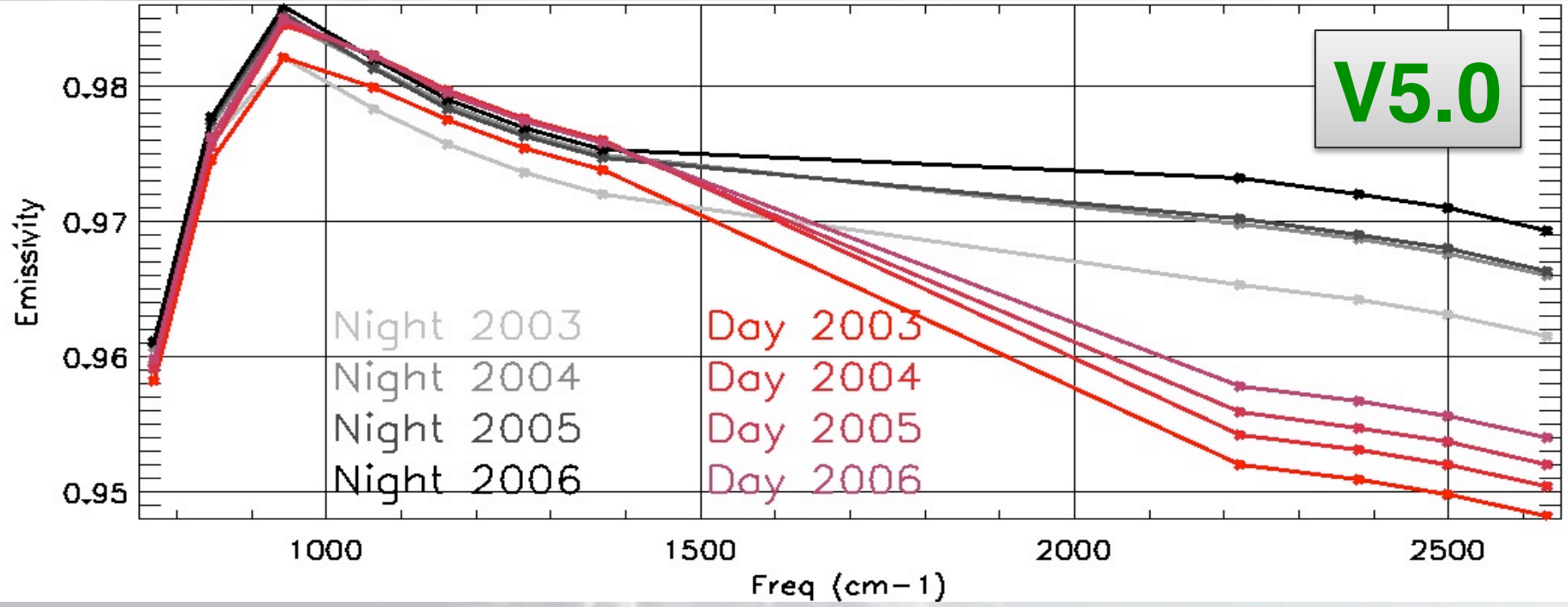
Tropical ocean emissivity spectrum v5.0



- **V5.0 tropical ocean emissivity:**
  - **Had a clear increasing trend at all frequencies**
  - **Had large day/night differences in the shortwave region**

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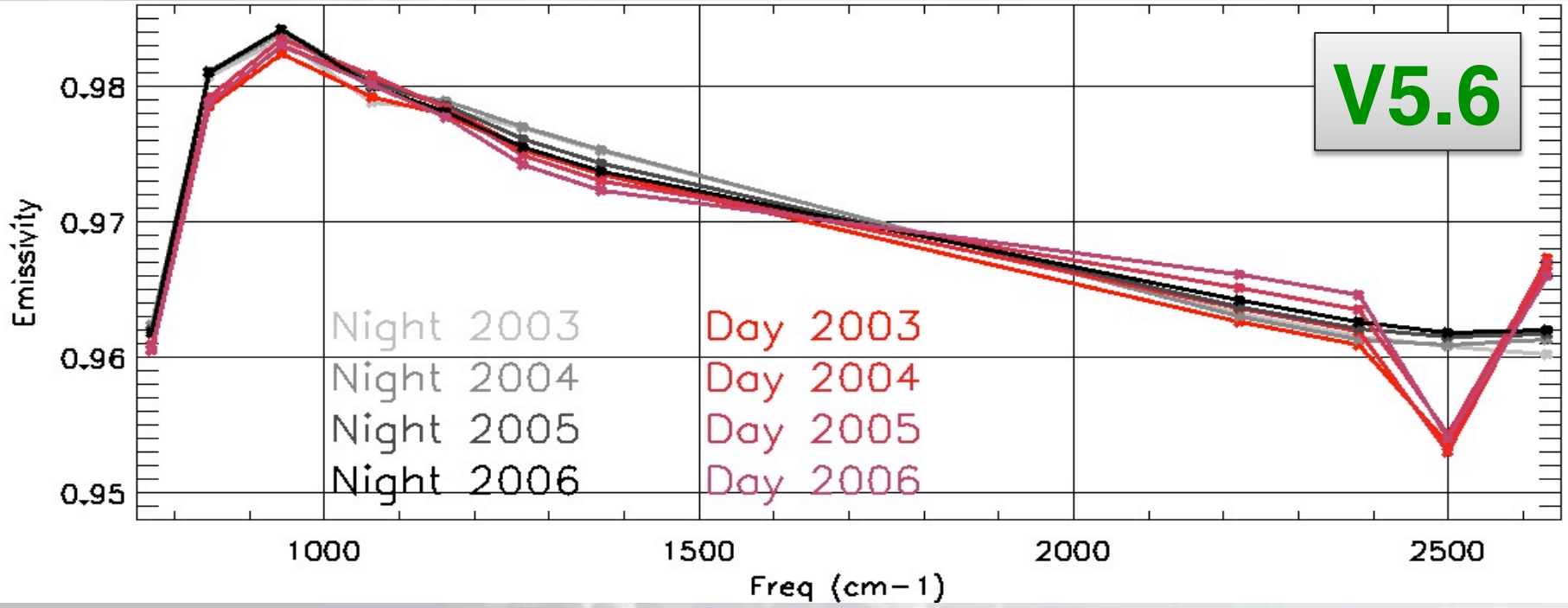
Tropical ocean emissivity spectrum v5.6



- **V5.6 tropical ocean emissivity:**
  - **Decreases trends at all frequencies**
    - Still has residual trends 1200-1400 & 2200-2400 cm-1
      - These are not window regions
      - Trend in 2200-2400 cm-1 may be only in daytime
  - **Decreases day/night differences in the shortwave region**
  - **Introduces a new kink in daytime shortwave emissivity**

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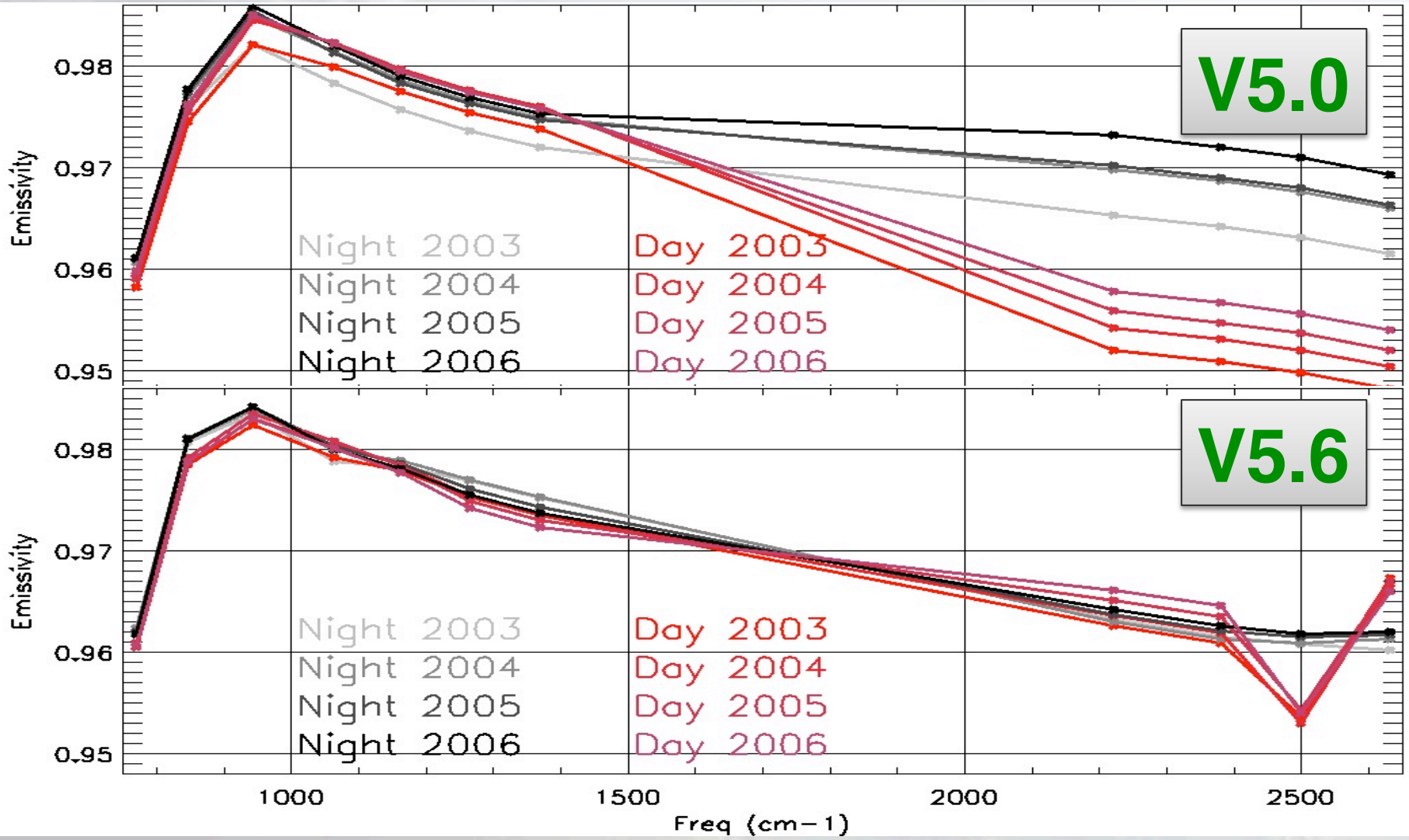
Tropical ocean emissivity spectra



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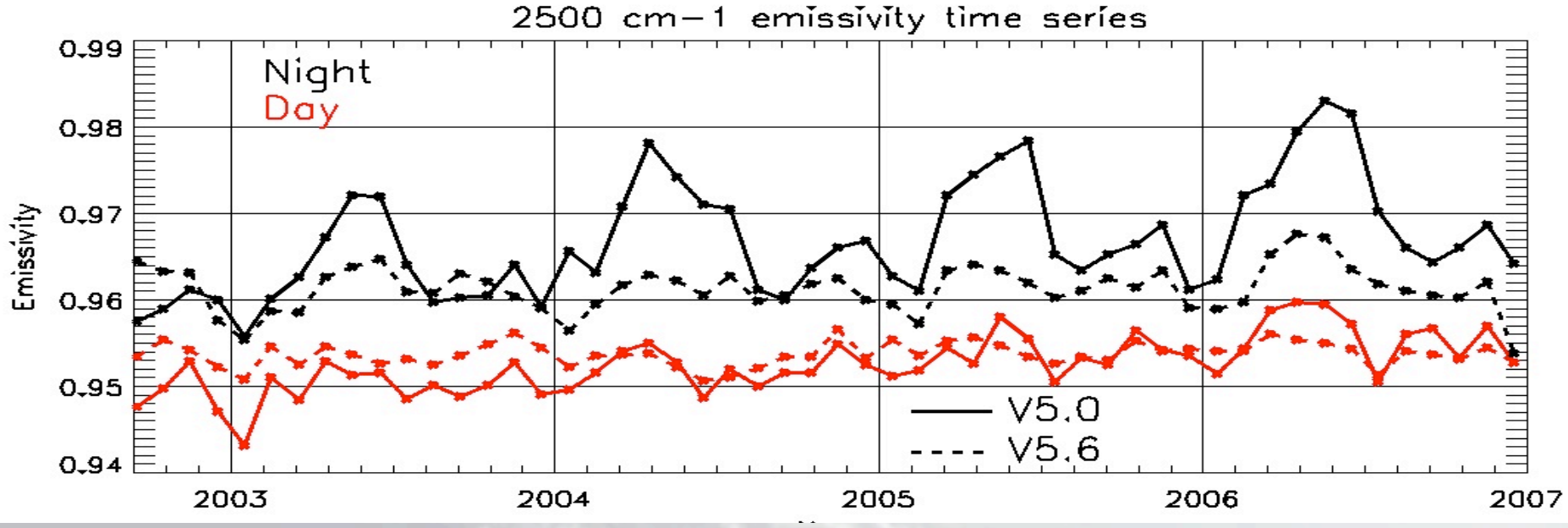
Ocean Emissivity by Month



- **V5.0 emissivity had a strong seasonal cycle in nighttime emissivity**
- **V5.6 does not**

Emissivity Conclusions

- **V5.6 ocean emissivity is better by most metrics:**
  - ✓ **Trend reduction**
    - X But some residual trend remains
  - ✓ **Day vs. night differences**
  - ✓ **Seasonal cycle**
  - ✓ **All cases with Emissivity > 1.0 eliminated**
  - ✓ **Cases with Emissivity < 0.95 greatly reduced**
  - X **Shortwave structure introduced**